The Raman-shifted excimer laser. More lines in the UV

E. Albers, D. Basting[*], H. Bücher, Y.U. Kudriavtsev[+]

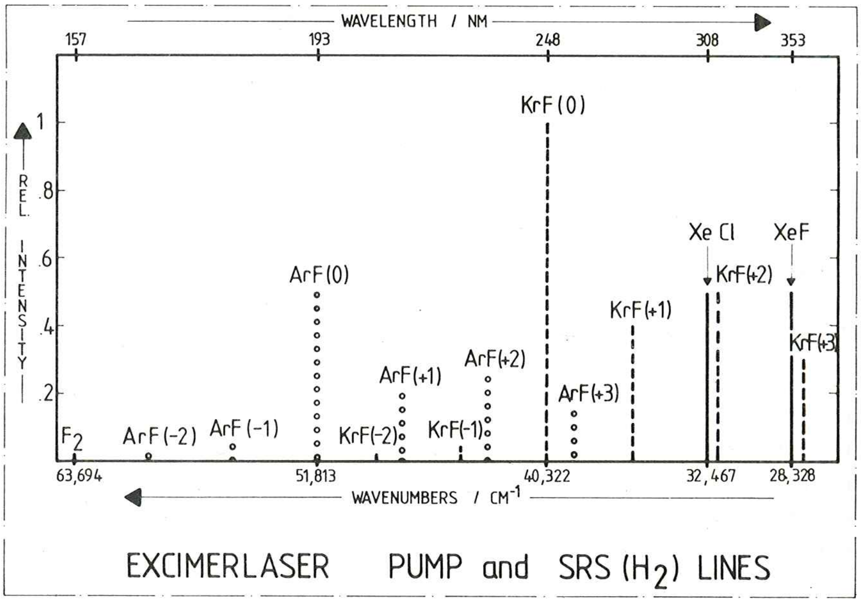
Lambda Physik, D-3400 Göttingen

Excimer lasers are a powerful source of radiation in the UV, providing laser lines between 157 nm to 353 nm.
The versatility of excimer lasers can be greatly improved with the addition of new spectral lines obtained by Raman-shifting fundamental radiation in hydrogen or other gases (1).

Raman-shifting requires a beam of high focussible power density. It is well known that the direct output of the discharge-pumped excimer laser with its rather large divergences will not allow efficient Raman-shifting despite its high pulse energy of several 100 mJ in approx. 20 ns.

In order to improve the beam quality, a commercial excimer laser (Lambda Physik EMG 100) was equipped with a positive branch unstable resonator. Although the output power was reduced to 50% or 60% an increase in brightness of 1 - 2 orders of magnitude was observed. Time resolved analysis of the beam quality could be done using the Raman process as a probe. It is found that only the temporal toul of the 20 ns pulse emitted by the laser has the spatial quality for high conversion efficiency.

Efficiency data as a function of Raman cell gas pressure and pulse energy are presented for KrF and ArF in H_2. The maximum efficiency which could be obtained was 40% for the first Stokes line, 48% for the second Stokes line and 5% for the first anti-Stokes lines. The results for the different wavelengths are shown in a diagram. Using gases other than H_2 would result in an even more complete coverage of the spectral range between 157 and 450 nm.



References

1. Topics in Applied Physics, 30, Ed. by Ch.R. Rhodes, Springer Verlag Berlin, Heidelberg, New York, 1979

T.R. Loree, R.C. Sze, D.L. Barker, P.B. Scott, IEEE J. Quant. Electr., QE-15, 337 (1979)

J.A. Paisner, R.S. Hargrove, priv. Communication, 1979

+ Permanent address: Institute of Spectroscopy, Moscow, UDSSR